PREPRODUCTION INITIATIVE
MOBILE OIL EVACUATION SYSTEM
FINAL REPORT

NAB Coronado

1.0 INTRODUCTION

The U.S. Navy has adopted a proactive and progressive position toward protecting the environment and complying with environmental laws and regulations. Rather than merely controlling and treating hazardous waste by end-of-the-pipe measures, the Navy has instituted a program for pollution prevention (P2) to reduce or eliminate the volume and toxicity of waste, air emissions, and effluent discharges.

P2 allows the Navy to meet or exceed current and future regulatory mandates and to achieve Navy-established goals for reducing hazardous waste generation and toxic chemical usage. P2 measures are implemented in a manner that maintains or enhances Navy readiness. Additional benefits include increased operational efficiency, reduced costs, and increased worker safety.

The Navy has truly set the standard for the procurement and implementation of P2 equipment. The Chief of Naval Operations (CNO), Environmental Protection, Safety, and Occupational Health Division (N45) established the P2 Equipment Program (PPEP), through which both the Naval Air Systems Command Lakehurst (NAVAIR LKE) and the Naval Facilities Engineering Service Center (NFESC) serve as procurement agents under the direction of N45. P2 equipment is specified and procured under two complementary initiatives: the Preproduction Initiative (*i.e.,* technology demonstration) and the Competitive Procurement Initiative. The Preproduction Initiative directly supports both the Navy Environmental Leadership Program (NELP) for P2 shore applications and the P2 Afloat program, which prototypes and procures P2 equipment specific to the needs of ships.

This report provides an analysis of the procurement, installation, and operation of P2 equipment under the Preproduction Initiative. Technology demonstrations and evaluations are primarily performed under the PPEP Preproduction Initiative at two designated NELP sites—Naval Air Station (NAS) North Island and Naval Station (NS) Mayport. Additional sites, such as NAB Coronado, have been added as required to meet specific mission goals. The program involves defining requirements, performing site surveys, procuring and installing equipment, training operators, and collecting data during an operational test period. The equipment is assessed for environmental benefits, labor and cost savings, and its ability to interface with site operations as well as its ability to perform the required functions.

2.0 BACKGROUND

The primary purpose of this technology demonstration is to improve the engine oil change process currently performed at NAB Coronado on rigid hull inflatable boats (RHIBs) at Special Boat Unit 12 (SBU-12). The RHIBs are 36-foot-long special operations boats that form an integral part of Navy Special Operations. RHIBs perform a variety of duties, such as coastal surveillance, coastal resupply, and SEAL insertion/extraction missions.

Navy maintenance practices require RHIB engine oil to be changed after every 75 hours of operation. Engine oil changes on the special operations boats are labor-intensive and difficult to perform because the two engines are closely placed in a small area. During the engine oil change process, oil can potentially spill into the RHIB's bilge, contaminating the bilge water.

The portable mobile oil evacuation and delivery system was proposed as a technology demonstration project under PPEP in an attempt to minimize waste generation, reduce the potential of oily water discharges, and reduce the labor effort required to perform oil changes.

2.1 Current U.S. Navy RHIB Oil Change Practices

During the PPEP evaluation, there were 34 RHIBs stationed at SBU-12. Each RHIB has two engines, and each engine contains 6.5 gallons of oil. The RHIBs follow a maintenance schedule that calls for changing the engine oil after every 75 operational hours, which amounts to an average of four engine oil changes per month.

The RHIB engine oil change is performed when the boat is next to the dock or out of the water for other scheduled maintenance or repairs. Permanently attached to each engine is a quick disconnect (QD) fitting connected to a hose attached to the bottom of the oil sump. A hand pump is attached to this QD fitting, and the sump is emptied into a 55-gallon drum or into 5-gallon cans that are then transferred to a 55-gallon drum. A warm engine facilitates hand pumping to remove the 6.5 gallons of oil contained in each engine. This waste oil is then disposed of as hazardous waste.

Fresh oil is added to the engine in a similar manner. The same hand pump is used to add the fresh oil from a 15-gallon drum into each engine through the same QD fitting.

The entire oil change process for both engines can take two men six hours. During this operation, oil can potentially spill onto the boat and/or dock. If a spill occurs, rags are used to clean it up, generating additional waste. Any oily residue that remains in the bilge area of the RHIB mixes with the bilge water and is discharged overboard when the bilge pump activates. Sometimes the RHIBs also undergo bilge cleanings at the same time as the oil change; other times, only the oil change is performed.

2.2 System Selection

PPEP sought to demonstrate a mobile oil evacuation and delivery system that would eliminate or reduce several safety and environmental concerns common to the current procedures, as well as reduce the man-hours required to perform an oil change.

It was important to find a system that would provide a safer working environment. The primary safety concern involved personnel working between two engines while performing manual oil changes. This process leaves little room to maneuver and can potentially lead to injury.

It was also important to find a system that would reduce the likelihood of spills and other environmental hazards. The primary environmental hazard was the generation of hazardous waste. Hazardous waste consisted of contaminated oil from the engine, as well as the rags used for cleanup.

Finally, it was considered necessary to reduce the man-hours required to perform the engine oil changes. Automating the process was viewed as the best way to accomplish this goal and ensure easy handling of the waste oil.

3.0 EQUIPMENT DESCRIPTION

3.1 Vendor Selection

Extensive vendor searches were conducted to identify a manufacturer of an oil evacuation and delivery system to meet the site's requirements. The results of this vendor search identified the A.M.O.S. 30/30 M, manufactured by American Marine Oil System, as the candidate system most likely to meet the requirements of this project.

3.2 System Components

The A.M.O.S. Model No. 30/30 M is a self-contained oil evacuation and delivery unit that includes, but is not limited to, the following major components:

- 6' x 13' trailer
- 4-kW gas powered generator or 110v/30-amp power (electric)
- 16 cubic foot lockable accessories box
- Two integral 35-gallon waste oil collection tanks
- 75' evacuation hose on recoiling reel
- Four 15-gallon tanks for dispensing fresh oil
- 75' fresh oil delivery hose
- Digital metered oil gun
- ¾-hp air compressor.

3.3 Method of Operation

The Mobile Oil Evacuation System (MOES) is powered by a 4-kW gas-powered generator (diesel option also available) or 110v/30-amp power (electric), and consists of a vacuum system, pressure system, evacuation and delivery hoses, fresh oil storage tanks, and used oil collection tanks. These main components are mounted on a trailer, enabling the MOES to be accessible at any station.

The operator's first step when using the MOES is to evacuate the oil from each RHIB engine. The vacuum system consists of a vacuum pump, 75-foot-long evacuation hose, and two 35-gallon waste oil collection tanks. The oil is evacuated into one of the waste oil collection tanks. Several boats can be serviced consecutively before draining the waste oil collection tanks. The length of the hose allows the boats to be serviced safely while in the water or on land. The waste oil collection tanks are drained via a short hose and nozzle into user-supplied drums for proper disposal. This drain hose is about 6 feet—long enough to adequately reach a disposal drum, but short enough to eliminate any chance of refilling an engine with used oil.

The next step is to fill each engine with fresh oil. The pressure system consists of a commercial gear pump and a separate 75-foot fresh oil delivery hose with metered delivery gun. New oil is delivered at a measured quantity via a digital meter incorporated within the oil delivery gun attached at the end of the delivery hose. Oil is dispensed from either one of the two 15-gallon drums of fresh oil. The gear pump delivering the fresh oil into the RHIB engine is controlled by the delivery gun.

3.4 Implementation Requirements

The specifications and requirements (as supplied by the manufacturer) for the A.M.O.S. 30/30 M include:

- Dimensions: 4' L x 4' W x 4' H without trailer
- Weight: 650 lb. without trailer
- Gasoline- or diesel-powered generator (Note: Gasoline-powered generator was selected by the site.)
- Electric start engine
- Outdoor use or inside maintenance areas.

3.5 Overall Benefits

The MOES has several potential benefits, including:

- Reduce oily water discharges to waterways and oil spills on land.
- Reduce the amount of hazardous waste generated.
- Provide a safer working environment.
- Improve the efficiency and effectiveness of oil changes; reduce labor hours.

The MOES' success in meeting these potential benefits is described below.

The MOES reduces spills that may occur on docks or beaches while performing oil changes. All oil, whether fresh or waste, is pumped directly into or out of the engine as opposed to being pumped into a pan/bucket and then transported to a hazardous waste drum.

Fewer rags are used in changing the oil because the potential for spills has been reduced by eliminating the transport of used oil from the engine and also the handling and pumping of new oil.

The MOES provides a safer working environment because it is a closed-loop system. Personnel hook up the hoses, and the MOES directly pumps the fresh oil and evacuates the waste oil, unlike the previous method whereby personnel used a hand pump to perform the engine oil changes and also had to transport the fresh and waste oil. Thus, personnel exposure to oil has been greatly reduced. In addition, by preventing oil spills, the risk of slip/trip/fall hazards is reduced.

The MOES has proved to be efficient and effective because it is an automated process. The MOES has reduced the man-hours required to perform oil changes by 84%.

4.0 DATA ANALYSIS

Data was collected between May 2002 and May 2003 using the Daily Log Sheets provided with the project Test Plan. The site provided sufficient data to analyze the MOES' technical capability and overall benefits.

4.1 Quantitative Analysis

4.1.1 Operational Data

During the test period, the MOES completely replaced the previous method of performing oil changes on the RHIBs. The following table displays average statistics based on data collected during the test period.

Average Statistics for RHIB Oil Changes			
	Previous Method	**MOES Method**	**% Reduction**
Number of oil changes per year	52	52	N/A
Man-hours to perform oil changes per year	624	104	84
Number of operators per oil change	2	1	50
Number of rags disposed of per year	520	156	70

4.1.2 Cost Analysis

The cost analysis showed a 10-year return on investment (ROI) of approximately $131,524.80 and a break-even point of approximately 1.46 years. The MOES does not have a significant effect on the cost or quantity of hazardous waste generation because the used oil can be considered equivalent for both methods. The man-hours required to perform oil changes using the MOES are significantly less than the conventional method, thus creating labor savings. Overall, the MOES was effective and efficient in the handling of hazardous materials and waste and in reducing labor hours.

4.2 Qualitative Analysis

4.2.1 Installation

The MOES is a self–powered (gasoline generator) trailer-mounted system, and therefore there are no installation requirements.

4.2.2 Training

A one-day training course was conducted May 14, 2002. Two representatives from American Marine Oil Service inspected the equipment, and provided startup and operator training. Personnel from SBU-12 were present for the training and for a safety review. The manual was reviewed in detail. The training was conducted at the maintenance yard of Beach Master Unit 1 (BMU-1) (across the street from SBU-12) due to space and BMU-1's interest in this equipment for use on the lighter amphibious resupply cargo (LARC) boats.

4.2.3 Maintainability and Repairs

The site performed regular scheduled maintenance according to technical requirements to keep the MOES in good working condition. Some maintenance procedures were preoperational checks, while others were periodic checks and/or servicing. The operational checks took an average of five minutes to complete before every usage. The periodic maintenance checks or servicing took an average of 30 minutes per month.

MOES maintenance consisted of the following schedule:

<u>Preoperational Procedures</u>

- Inspect hoses and fittings.
- Inspect inside of machine through opening in back.
- Check tanks and hoses for any sign of oil/fluid leakage.
- Check power cord for jack tear and/or prong damage.
- Test panel alarm.

Six-Month Maintenance Operations

- Change oil delivery filter.
- Change oil mist filter.
- Check oil reel swivel and fittings for debris.

Yearly Maintenance Operations

- Remove and replace oil meter gun battery.
- Align voltage meter.

During the test period at SBU-12 at NAB Coronado, the MOES had no maintenance issues and did not require any repairs.

4.2.4 Interface with Site Operations

The MOES significantly improved maintenance operations at SBU-12. The ease and speed with which the oil changes were conducted using the MOES made the process more efficient and effective. By using the MOES, personnel did not have to manually pump the oil to and from the engine, creating a safer working environment, quicker oil change time, and less hazardous waste. No modifications were needed at the site to implement the MOES. The MOES did involve additional maintenance checks, but the overall labor savings offset the hours for these additional checks.

The MOES is versatile enough to perform oil changes on a variety of small boats. For this test period, the MOES was configured for use with the RHIBs. In addition to the RHIBs, SBU-12 maintains and operates MARK-V special operations boats. SBU-12 was also interested in performing engine oil changes on the MARK-V with the MOES. To facilitate this, an adapter was purchased and stored on each MARK-V. This adapter allows the MOES hoses to connect with the fittings on the MARK-V engine.

BMU-1 expressed interest in using the MOES to maintain its LARC fleet. Each LARC has three different components requiring oil changes—the engine, the forward/reverse gearbox, and the transfer gearbox. To perform oil changes using the MOES, oil evacuation kits were purchased and attached to the sump of each component. The kits consisted of a QD fitting, a length of metal-shielded hose, a sump connection, and mounting hardware. The vendor also provided installation training for the kits.

It should be noted that although data were not collected for using the MOES to perform oil changes on the MARK-V and LARCs, the unit was successfully used on both types of boats. BMU-1 personnel reported the same labor savings, favorable experiences, and enthusiasm for incorporating this equipment into their maintenance procedures.

4.2.5 *Environmental Impact*

The MOES created an environmental impact on air emissions that the current method did not. The Generac generator that powers the MOES is a 4-kW gasoline-powered generator that complies with California Air Resource Board regulations and that is EPA emissions-certified as confirmed by the manufacturer. According to the Code of Federal Regulations for Control of Emissions from nonroad spark-ignition engines at or below 19 kW (40 CFR 90.103), the Generac generator does not exceed the following levels of exhaust emissions: 16.1 g/kW-hr. of hydrocarbons plus nitrogen oxides and 519 g/kW-hr. of carbon monoxide.

Since the MOES is not operated continuously on a daily basis, air emissions from the generator are relatively minimal. The MOES is generally powered by electric power, which does not produce any air emissions. The generator is used to power the MOES when electricity is not available. The positive environmental impacts from the MOES, such as reduction of hazardous materials used and waste generated, and the significantly decreased potential for spills, compensate for the small increase in air emissions from Navy operations.

4.2.6 *Overall Performance*

Overall, the site was very satisfied with the performance of the MOES. It provided a more efficient way of performing oil changes while creating a more productive working environment. It also reduced spills.

4.3 Project Costs

The following table presents costs incurred during implementation of this project. Please note that these costs are not necessarily the same as the initial procurement costs used in the Cost Analysis because the initial procurement costs reflect the costs for the RHIBs only, not the additional fittings required for other boats used at NAB Coronado, such as the LARC and MARK-V.

Item	Quantity	Unit Cost	Extended Cost
A.M.O.S. 30/30 M configured for RHIBs	1	$22,500.00	$22,500.00
Adapters for MARK-V	4	$105.00	$420.00
Crank case evacuation kits for LARCs	70	$131.00	$9,170.00
		Total Equipment Cost	**$32,090.00**

As stated above, the MOES was also used on the MARK V at SBU-12, which required an adapter/QD fitting. The cost for the adapter was $105.00. Four adapters were purchased and placed on each MARK V at the site for a total of $420.00.

For MOES to be used on the LARCs at BMU-1, the oil evacuation kits described in Section 4.2.4 were purchased to allow the connection. Each evacuation kit cost $131.00.

Three kits were needed for each of the 23 LARCs at BMU-1. The total amount for all kits, including one spare three-kit set for all 23 LARCs, was $9,170.00.

5.0 RECOMMENDATIONS, LESSONS LEARNED, AND FUTURE USES

At the beginning of the MOES evaluation, the equipment was readily integrated into the site's operations. Personnel found the equipment easy to use, and they did not hesitate to operate the MOES during regularly scheduled oil changes on the RHIBs.

Modifications that personnel suggested for the MOES during the PPEP evaluation period are as follows:

- The evacuation hose should include a magnetic strainer to remove metallic debris/contamination.
- A digital gauge with a visual indication of how much oil has been emptied out of the MOES during disposal of waste oil would be helpful. This will also aid in the requirement to track and report on hazardous wastes disposed of.

There is great potential for use of the MOES to change oil on most boats and several types of equipment that have an oil sump.

6.0 CONCLUSIONS

Significant labor savings are realized due to the reduced labor required to perform engine oil changes with the MOES. Of additional importance, the MOES is a safer alternative than the current method because it does not require personnel to be in the bilge area to perform engine oil changes and because it reduces the potential for spills. The cost analysis showed a 10-year return on investment of approximately $131,524.80 and a break-even point of approximately 1.46 years. The unit may be useful for performing oil changes on other types of small boats and possibly other types of equipment.